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RESEARCH ARTICLE

Number of revolutions of a particle around a black hole: Is it infinite or finite?

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Abstract We consider a particle falling into a rotating black hole. Such a particle makes an infinite number of revolutions n from the viewpoint of a remote observer who uses the Boyer–Lindquist type of coordinates. We examine the behavior of n when it is measured with respect to a local reference frame that also rotates due to dragging effect of spacetime. The crucial point consists here in the observation that for a nonextremal black hole, the leading contributions to n from a particle itself and the reference frame have the same form being in fact universal, so that divergences mutually cancel. As a result, the relative number of revolutions turns out to be finite. For the extremal black hole this is not so, n can be infinite. Different choices of the local reference frame are considered, the results turn out to be the same qualitatively. For illustration, we discuss two explicit examples—rotation in the flat spacetime and in the Kerr metric.

Keywords Black holes · Kerr metric · Rotating Frames

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